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Coherent manipulation of dipolar coupled spins in an anisotropic environment

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Abstract

© 2014 American Physical Society. We study coherent dynamics in a system of dipolar coupled spin qubits diluted in a solid and subjected to a driving microwave field. In the case of rare earth ions, an anisotropic crystal background results in anisotropic g tensor and thus modifies the dipolar coupling. We develop a microscopic theory of spin relaxation in a transient regime for the frequently encountered case of axially symmetric crystal field. The calculated decoherence rate is nonlinear in the Rabi frequency. We show that the direction of a static magnetic field that corresponds to the highest spin g factor is preferable in order to obtain a higher number of coherent qubit operations. The results of calculations are in excellent agreement with our experimental data on Rabi oscillations recorded for a series of CaWO4 crystals with different concentrations of Nd3+ ions.

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